Spectroscopic comprehensive studies of natural and synthetic opals

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Novel class of dielectric structures with a refractive index which exhibits spatially periodic modulation is known as photonic crystals. Photonic crystals do not occur naturally, except for a well-known gemstone natural opal with brilliance light scattering in the visible range. Both natural and synthetic opals are made up of closely packed uniformly sized SiO_2 - spheres with diameter on the scale of a micrometer.

In the present work AFM and optical spectroscopic comparison studies of the both types of opals are carried out. We found Bragg diffraction spectral bands of the natural opals to be significantly narrower as compared to that of unfilled synthetic materials. Numerical calculations were performed within the model of a planar periodic layered medium making use of the transfer matrix technique, which indicate that the voids between SiO_2 - spheres in the natural opals are filled with glass-like rock. From the spectra observed the information about real structure of synthetic opals has been extracted with an account of anisotropic shrinkage and sintering of SiO_2 – spheres.

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